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PROJECT

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DRAFT

Aquarius Ground System – Aquarius Instrument Team ICD

AQ-336-0522

Summary

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MODIFICATIONS LIST

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REFERENCES & APPLICABLE DOCUMENTS

Nº:	TITLE
	Aquarius Project Document List
AQ-385-0116	AQ - ICDS Command Dictionary
AQ-385-O115	AQ - ICDS Telemetry Dictionary
AQ-355-0144	AQ - Instrument Ops Procedures
AQ-417-0521	AQ - Aquarius Command & Control Segment (ACCS) Policies, Processes and Procedures Document
TBD	Aquarius Flight Anomaly Resolution Procedure

1.   Introduction

During flight, the Aquarius Mission Operations team and the Aquarius instrument team will interface in order to diagnose and resolve instrument anomalies.

The Aquarius Mission Operations team monitors instrument health, performs command scheduling, and provides initial diagnosis in the event of a ground system or instrument problem. The Mission Operations team also exercises any scripts or procedures developed by the anomaly resolution team against the Aquarius test bed prior to implementation on the flight instrument.

The Instrument Team develops, integrates and tests the instrument, performs the on-orbit checkout sequence, and provides ad hoc support for anomaly analysis and resolution. This support includes any software patch development and bench testing that may be required to resolve an anomaly as well as any specific command sequences.

1.1 Purpose and Scope

This document describes the interfaces between the Aquarius Instrument Team (JPL and GSFC) and the Aquarius Mission Operations team (GSFC) including voice, data, reports, and scripts.

1.2 Background

The Aquarius/SAC-D mission is designed to provide global Sea Surface Salinity maps by measuring the brightness temperature of the sea surfaces at L-band, 1413 MHz and correlating those measurements with Sea Surface Temperatures, collected as ancillary data. The Aquarius instrument consists of the L-band Radiometer and an L-band Scatterometer (active radar), operating at 1241 MHz. The Scatterometer is employed to provide a correction for sea surface roughness, a primary component of the Aquarius error budget.

The SAC-D Service Platform is being built by CONAE, the Argentine government's space agency, in conjunction with INVAP, a commercial Argentine space company. SAC-D is also hosting several other science instruments that will support Argentine-sponsored science projects.

The Radiometer portion of the Aquarius instrument is being built at GSFC; the Scatterometer at JPL. Aquarius data processing and instrument operations are also GSFC responsibilities. Mission Operations will be performed jointly by GSFC and CONAE.

1.3 Organization

The Aquarius Instrument Manager and the Aquarius Ground System Engineer are jointly responsible for establishing these interfaces under the control of the JPL Aquarius Project Office.

2   Anomaly Resolution Process

The Aquarius anomaly resolution procedure is described in the Aquarius document, "Aquarius Flight Anomaly Resolution Procedure". At a high level, the procedure states that any anomaly on the Aquarius/SAC-D Observatory is resolved under the leadership of the CONAE Mission Operations Manager. The Aquarius anomaly resolution procedure is a sub-process of the CONAE procedure in which the Aquarius Mission Operations Lead serves as the Aquarius Mission Operations Manager. The Aquarius and CONAE Operations Managers then coordinate action plans together, notifying and gathering the appropriate personnel required to diagnose, resolve, approve, and implement restoration to service.

The Aquarius anomaly resolution procedure assumes that either the CONAE flight operations team or the Aquarius flight operation team may observe an Aquarius anomaly. In that event, either party is to file a Flight Anomaly Report and transmit it to the CONAE Mission Operations Manager. The CONAE Mission Operations Manager then contacts any CONAE technical and management support required; the Aquarius Mission Operations Lead contacts Aquarius management support. The Aquarius management support includes the JPL liaison who contacts the technical support required from the JPL and GSFC instrument team.

From this point, the instrument team, the Aquarius Mission Operations Lead, and the CONAE Mission Operations Manager must transfer information amongst each other in various forms in order to diagnose the anomaly, discuss and select a resolution, obtain approval, and implement the resolution selected. The instrument team needs the initial anomaly description filed in the Flight Anomaly Report. They also need technical data such as the Observatory's orbit position, any pertinent commands executed around the time of the anomaly, playback science and HKT data, and any other information that might be required in order to understand the problem.

The Aquarius Mission Operations Lead needs to follow the diagnosis process, consider and provide other pertinent information, encapsulate information into progress reports and disseminate them to Aquarius management and to the CONAE Mission Operations Manager, structure any command sequences identified by the instrument team into scripts and procedures, test the scripts and procedures against the Aquarius test bed, then coordinate the implementation of the final approved plan with the CONAE Mission Operations Manager.

3. Data and Information Exchanged

The information that the Aquarius Mission Operations team provides to the Aquarius instrument/anomaly resolution team includes:

- The initial Flight Anomaly Report
- Associated technical data (playback files, pertinent commands, etc)
- Aquarius test bed remote access
- Command upload opportunities (date/time/duration)
- Operations procedures and scripts based on instrument team inputs

- Notification of Science Control Board plan approval
- Electronic copy of the closed Flight Anomaly Report

The information that the Aquarius instrument/anomaly resolution team provides to the Aquarius Mission Operations team includes:

- Anomaly resolution status reports
- Requests for additional information
- Command sequences to be tested
- Final command sequences
- Confirmation of Operations procedures and scripts

4. Interfaces and Formats

The Aquarius Ground System to Science Team interfaces rely on the Aquarius Reporting and Tracking Tool as the mechanism to support active and archived communications between groups. Each participant in the interactions listed in sections 4.4 must also become a subscriber to the Aquarius Reporting and Tracking Tool (ARTT). The ARTT will automatically email subscribers when new Tickets are entered so participants must provide a reliable email address in order to receive the various notifications shown below.

"Tickets" include (but are not limited to):
- Algorithm source code delivered from the Science Team
- Requests from the Science Team to change ancillary data sources
- Requests from the Science Team to update Aquarius science algorithms
- Requests from the Science Team to change the configuration of the instrument
- Requests from the Science Team to perform a Cold Sky Calibration maneuver
- Anomaly reports

Potential subscribers will include team members from Aquarius science, instrument, CONAE/SAC-D mission operations and management, and Aquarius mission operations and management.

Required subscribers and their email addresses are:

Gary Lagerloef _____ lager@esr.org
David LeVine   _____ david.m.levine@nasa.gov
Yi Chao _____yi.chao@jpl.nasa.gov
Gene Feldman _____gene.c.feldman@nasa.gov
Fred Patt _____ frederick.s.patt@nasa.gov
Daniel Caruso _____caruso@conae.gov.ar
(CONAE site mgr) _____email TBD
(CONAE Mission Ops Mgr) _____email TBD
Felipe Pasquevich _____felipe@conae.gov.ar

Liang Hong _____ liang@seawifs.gsfc.nasa.gov
Susan Kennison _____ susan.l.kennison@nasa.gov

The URL for accessing the Aquarius Reporting and Tracking Tool is:

http://oceancolor.gsfc.nasa.gov/AQUARIUS/TRAC

4.1.   Anomaly Resolution Information Exchanged

The information that the Aquarius Mission Operations team provides to the Aquarius Instrument team in the event of an anomaly includes:

- The initial Flight Anomaly Report
- Data/information associated with the anomaly
- Proposed Operations procedures based on received command sequences from the instrument team
- Notification that the proposed resolution (Operations procedure) has been submitted to the Science Control Board
- Notification of Science Control Board plan approval
- Command upload opportunities (date/time/duration)
- Status report on the results of the Operations Plan (resolution) implementation
- The final (closed) Flight Anomaly Report

The information that the Aquarius instrument team provides to the Aquarius Mission Operations team for anomaly resolutions includes:

- Acknowledgment of the initial anomaly report
- Requests for additional information
- Anomaly resolution status reports
- Proposed resolution (command sequences)
- Technical approval of the final Operations Procedure (resolution)

4.2. Anomaly Resolution Information Formats

The Flight Anomaly Report Form is shown in FORM 4.2.1

Flight Anomaly Report

AQUARIUS/SAC-D		CONAE	FAR nº:
FLIGHT ANOMALY REPORT FORM (FAR)			**PAG 1 OF**
ORIGINATOR:	**PHONE:**		**DATE:**
TO:			**ORGANIZATION:**
LOCATION OF ANOMALY:			
DESCRIPTION OF THE EVENT:			
SAFETY, COST, SCHEDULE, REQUIREMENTS IMPACT: ☐ YES ☐ NO			
DESIGNEE::			
CORRECTIVE ACTION:			
APPROVALS		**OTHER APPROBALS (Specify)**	
SAFARB CAHIRMAN **DATE:** **ORIGINATOR ORGANIZATION PROJECT MANAGER** **DATE:**			

Table 4.2.1 Command sequence example.

Pass Times/Durations

```
Name EventID Start     End     Duration ElMax    ElCut   AzRise     AzSet RangeMin TLENumber    RevNum      Comments
SAC-C MGS 2006/10/12 07:23:09.0 2006/10/12 07:34:45.0 00:11:36 12.4  0 186.8 77.5 2063.7   2235   31322 Comment1
SAC-C AGS 2006/10/12 08:02:32.5 2006/10/12 08:15:20.5 00:12:48 20.7  0 209.8 340.8 1578.5  2235   31322 Comment2
```

Table 4.2.2 GS Contacts File Example.

Command sequence template

Step	S/P cmd	Param	AQ cmd	Param	Tlm check	Notes
Aq_ICDS_pwr	on, prime			yes	ICDS and ATC ctrlrs will be powered on. FSW initializes, enables interrupts, rad timing is on, scat timing is off, telemetry is collected and block are written to DRAM. Can receive gnd commands after 60 sec. Gnd to assess ICDS health	
		I_select_downlink	primary			to be turned on autonomously by S/P ASAP after launch, Aq ground team to verify heater currents and Aq radiator temps
		I_start_downlink				
		I_stop_downlink				
					verify ICDS health from high rate data	

Table 4.2.3 Command sequence example.

Command Script template

The command script syntax and format are:

```
scl  subsystem::scriptname

{
Aquarius::command from AQBasicCommands (param1, param2, param3);
}
```

Example

```
scl ATC::setpoint

{
Aquarius::ATC_temp_setpoint(1,65535,20);
}
```

Table 4.2.4 Command script template.

Additional command scripting features are available in the CONAE document SAC-D SCL User's Guide.

4.3.   Anomaly Resolution Interfaces

The specific interfaces for each type of information to be exchanged are listed in Tables 4.3.1 and 4.3.2.

Exchanged Information	Interface	Description
Initial Flight Anomaly Report	MO_I_ARTT_N	Aquarius Reporting and Tracking Tool entry/attachment
Additional anomaly data	MO_I_ARTT_D MO_I_graphs	Aquarius Reporting and Tracking Tool entry, Ocean Biology web-based graphs
Status Reports	MO_I_ARTT_SR	Aquarius Reporting and Tracking Tool
Pass Times/Durations	MO_I_ARTT_Pass	Aquarius Reporting and Tracking Tool entry or attachment
Proposed Operations Procedures	MO_I_ARTT_Proc	Aquarius Reporting and Tracking Tool entry or attachment
Request for Technical Approval	MO_I_ARTT_RTA	Aquarius Reporting and Tracking Tool entry
Notification of Science Control Board Approval	MO_I_ARTT_NSA	Aquarius Reporting and Tracking Tool
Final Flight Anomaly Report	MO_I_ARTT_F	Aquarius Reporting and Tracking Tool entry/attachment

Table 4.3.1 Aquarius Mission Operations team to Aquarius Instrument anomaly resolution team interfaces.

Exchanged Information	Interface	Description

Acknowledgement of Anomaly Report Receipt	I_MO_ARTT_ACK	Aquarius Reporting and Tracking Tool entry
Additional data requests	I_MO_ARTT_DR	Aquarius Reporting and Tracking Tool entry
Status Reports	I_MO_ARTT_SR	Aquarius Reporting and Tracking Tool
Proposed resolution (command sequences)	I_MO_ARTT_PR	Aquarius Reporting and Tracking Tool entry
Technical approval of final Operations procedure	I_MO_ARTT_TA	Aquarius Reporting and Tracking Tool entry

Table 4.3.2 Aquarius Instrument anomaly resolution team to Aquarius Mission Operations team interfaces.

The Aquarius Reporting and Tracking Tool is accessed via this URL:

http://oceancolor.gsfc.nasa.gov/AQUARIUS/TRAC/

and the Ocean Biology web-based graphs are located here:

http://oceancolor.gsfc.nasa.gov/AQUARIUS/MissionOps/graphs

GLOSSARY

AQ GS	Aquarius Ground System
CONAE	Comision Nationale Argentina Espaciale
GSFC	Goddard Space Flight Center
JPL	Jet Propulsion Laboratory
MOC	Mission Control Center
PI	Principal Investigator
SSS	Sea Surface Salinity
SST	Sea Surface Temperature